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SCREENING TESTS OF ORGANIC INSECTICIDES AGAINST CALIFORNIA RED SCALE, THIRD REPORT

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The results of screening tests with new insecticides against the California red scale (Aonidiella aurantii (Maskell)) at Whittier, Calif., were reported by Cressman et al.1/ for 1949 through 1955 and by Cressman and Gilmore2/ for 1956 to 1958. This report contains the results of laboratory tests conducted from 1958 through 1962 and of field tests with Shell SD-3562.

Experimental Procedure

The screening procedure for the 1958-60 tests was the same as that described by Cressman et al. Materials, unless otherwise indicated, were applied as wettable powders in sprays to mature scales on lemons with a pressure sprayer at 35 pounds per square inch. Following the treatment the scales were held in a lath house outdoors until mortality counts were made about 8 weeks later.

After relocation of the laboratory facilities to Riverside, Calif., early in 1961, the same procedure was used for the 1961 tests, except that the scales were held in a room at 80° F. and 70-percent relative humidity following treatment, and the holding interval before making mortality counts was shortened to 6 weeks. The air in the holding room was circulated through a filter of activated carbon at the rate of 100 c.f.m. to minimize fumigating action of the spray chemicals.

Early in 1962 an atomizer type of laboratory sprayer was installed, and further changes in methods were necessary. For the 1962 tests the candidate technical materials were formulated as 10-percent (wt./vol.) emulsifiable concentrates, using 5-percent (wt./vol.) of Atlox 1256 as the emulsifying agent and xylene as the solvent where possible. At the beginning of each series of tests, the sprayer was calibrated to deliver 19 ml. of material during a 9-second period. It was controlled automatically by a reset timer. Parathion, as a standard, was applied at concentrations of 0.5 and 1.0 gram

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1/ Cressman, A. W., Broadbent, B. M., and Munger F. Screening tests of some organic insecticides against the California red scale. U.S. Dept. Agr. ARS-33-40, 7 pp. 1957.

2/ Cressman, A. W., and Gilmore, J. E. Screening tests of organic insecticides against California red scale, second report. U.S. Dept. Agr. ARS-33-68, 8 pp. 1961.

per liter as compared with 1.0 and 2.0 grams per liter of the candidate materials. Lemons bearing mature scales were sprayed singly on a turntable, which made three complete revolutions during the 9-second period. Spraying was stopped just before runoff. Six lemons were sprayed with each concentration of the materials. Following the applications, the holding and counting procedure was the same as that used for the earlier tests.

The new sprayer (fig. 1) was the same as one described by Jeppson and

Figure 1.—Laboratory spray atomizer and accessory apparatus for screening new chemicals against California red scale. Inset (upper left) shows closeup view.

Jesser,[3] except for certain modifications. These included overhead agitation of the spray chemicals in the tank; mounting of the sprayer and certain accessory equipment on a sturdy wooden framework, which was adjustable in height and angle of delivery; and utilization of a shutter in the delivery of sprays. Initial performance studies of the sprayer without the shutter in the application of wettable-powder formulations showed that deposits of spray solids were considerably less than expected. It was concluded that this was due to the settling of solids in the tube connecting the tank and spray chamber of the gun during the interruption of sprays between lemons. Therefore, the initial spray mixture delivered from the gun at the start was low in solids.

The shutter arrangement was then installed to shield the spray from the lemon for 20 seconds to clear the liquid from the tube. When the tube was cleared, the shutter was moved to the open position by a solenoid connected to an electronic reset timer, and the spray stream was allowed to pass to the lemon. At the end of the 9-second spray period, the shutter was closed automatically by the timer. The use of the shutter increased the deposits of spray solids considerably, but they were still less than expected. It was decided, therefore, to use formulations of emulsifiable concentrates, which would be more stable. The shutter apparatus was retained to minimize the effects of possible creaming of emulsions.

Laboratory Tests

Compounds that gave at least 50-percent mortality of the mature female scales at a concentration equivalent to the highest parathion dosage, or that had a marked residual effect, are listed in table 1. Materials that appeared to be about equal to or better than parathion included Bayer 24498, Shell SD-3562, and American Cyanamid CL-43064. These three compounds showed sufficient promise to justify field evaluation.

In preliminary tests, stems of scale-infested lemons were immersed in solutions of Shell SD-3562 at concentrations of 1:100 and 1:1000. Different periods of immersion at various ages of the scales were tested. The higher concentrations showed an appreciable effect on the scale crawlers after an immersion period of 6 hours. At this concentration the effect diminished as the age of the scales increased and was insignificant when the scales reached maturity, even though the immersion time was increased to 24 hours. The lower concentration caused no appreciable effect, even on the younger stages.

Field Tests

A preliminary field test was started in October 1961 to determine possible phytotoxicity of Shell SD-3562. Valencia orange trees, which had been designated for removal, were sprayed with solutions of this material at the rate of 0.375 and 0.75 pound technical plus 1.5 oz. of Tween 20 per 100 gallons. Six trees were sprayed with each concentration at the rate of 25 to 30 gallons per tree. Frequent observations over 2 months indicated no damage to either fruit or foliage.

3/ Jeppson, L. R., and Jesser, M. J. Laboratory studies on resistance of the Pacific spider mite to acaricides. Jour. Econ. Ent. 55: 78-82. 1962.

A field test was started in October 1962 to evaluate Shell SD-3562 against the California red scale. Sprays of a solution containing 0.5 pound of technical Shell SD-3562 and 1.5 oz. of Tween 20 per 100 gallons were applied to Valencia orange trees moderately infested with red scale. Parathion emulsifiable concentrate at 0.375 pound technical per 100 gallons was applied as a standard. Two replicated plots of each were established.

When mortality counts were made 2 months later, it was noted that the covers had loosened and shed from a large number of scales sprayed with Shell SD-3562, and other covers of some immature scales were not developing normally. The counts showed 43 percent of the scales on fruit and 18 percent on wood had missing or abnormal covers. The number of such scales in the parathion plots was negligible. As usual, parathion was more effective against scales on the wood than on the fruit. By comparison, Shell SD-3562 was more effective than parathion against scales on the fruit and was about equal on the wood. Final evaluations will be based on scale population counts to be made about 1 year from the date of treatment. As in the earlier test, there was no plant injury from these sprays.

Materials Used

Chemical names of proprietary products[4/] and other materials that had little or no effect on the California red scale at a concentration equivalent to the highest parathion dosage are as follows:

American Oil LS-0564 (Indopol polybutene)
Bayer 23655 (S-(2-(ethylsulfinyl)-1-methylethyl) O,O-dimethyl phosphorothioate)
Bayer 32651 (4-methylthio-m-tolyl methylcarbamate)
Bayer 39007 (o-isopropoxyphenyl methylcarbamate)
Bayer 44646 (4-dimethylamino-m-tolyl methylcarbamate)
Binapacryl (2-sec-butyl-4,6-dinitrophenyl 3-methyl-2-butenoate)
Davidson Chemical SG-68 (silicon dioxide)
Davidson Chemical SG-78 (silica gel plus 3.85 percent $MgSiF_6 - H_2O$)
Dri-die (silicon dioxide plus ammonium silicofluoride to extent of 3 percent fluorine)
Geigy G-30494 (S-(2,5-dichlorophenylthio)methyl O,O-dimethyl phosphorodithioate)
Grace Research ACR-58-26 (chloromethyl trimethyl pyrophosphate)
Hercules 7522-H (6-chloro-m-cumenyl methylcarbamate)
Menazon (S-((4,6-diamino-s-triazin-2-yl)methyl) O,O-dimethyl phosphorodithioate)
Niagara 5943 (N',N',N",N"-tetramethyl-N-(5-phenyl-(4H)-1,2,4-triazol-3-yl) phosphoric triamide)
Shell SD-4294 (dimethyl 2-(alpha-methylbenzyloxycarbonyl)-1-methylvinyl phosphate)

4/ The mention of proprietary products does not constitute their endorsement by the U.S. Department of Agriculture over similar products not named.

Shell SD-5539 (m-nitrobenzyl 3-hydroxycrotonate dimethyl phosphate)
Stauffer B-8778 (O-isobutyl (chloromethyl)-phosphonothioate, O-anhydride with diethyl phosphate)
Stauffer N-2310 (O-(2 chloro-4-nitrophenyl) O-methyl ethylphosphonothioate)
Stauffer N-2789 (O-ethyl S-o-tolyl ethylphosphonodithioate)
Stauffer N-2790 (O-ethyl S-phenyl ethylphosphonodithioate)
Stauffer N-2860 (S-(p-chlorophenylthio)methyl O-ethyl ethylphosphonodithioate)
Stauffer N-3051 (S-p-tert-butylphenyl O-ethyl ethylphosphonodithioate)
U.C.C. (Cellosize QP4400)
Upjohn TUC 12927 (6-chloro-3,4-xylyl methylcarbamate)
Velsicol 58-CS-39 (4-allyl 1-(2-mercaptopropyl) mercaptosuccinate, S,S'-bis(O,O-dimethyl phosphorodithioate)
Velsicol 58-CS-51 (1,1'-thiodi-2-propanethiol, S,S'-bis(O,O-dimethyl phosphorodithioate)
Velsicol 58-CS-56 (diethyl 2,2-dimercaptosuccinate, S,S'-bis(O,O-dimethyl phosphorodithioate)
Wyandotte W-24 (alpha-methyl-4-morpholineacetonitrile)

Chemical names of proprietary products and other materials that were toxic to the California red scale, as indicated in the text and in table 1, are as follows:

American Cyanamid 43064 (2-(diethoxyphosphinothioylimino)-1,3-dithiolane)
Bayer 21907 (S-2-(ethylsulfinyl)ethyl O,O-dimethyl phosphorothioate)
Bayer 24498 (O,O-dimethyl S-2-(methylsulfinyl)ethyl phosphorothioate)
Bayer 41831 (O,O-dimethyl O-4-nitro-m-tolyl phosphorothioate)
Bayer 46676 (O-ethyl O-(2-ethyl-6-methyl-4-pyrimidimyl) ethylphosphonothioate)
DuPont 691 (O-p-nitrophenyl O-ethyl (chloromethyl) phosphonothioate)
Methyl Trithion (O,O-dimethyl S-p-chlorophenylthiomethyl phosphorodithioate)
Shell SD-3562 (2-dimethylcarbamoyl-1-methylvinyl dimethyl phosphate)
Stauffer B-8760 (O-isopropyl (chloromethyl)phosphonothioate O-diisopropyl phosphate)
Stauffer N-2230 (O-(2-chloro-4-nitrophenyl) O-ethyl ethylphosphonothioate)
Stauffer N-2404 (O-(2-chloro-4-nitrophenyl) O-isopropyl ethylphosphonothioate)

Table 1.—Comparative toxicity and residual effectiveness of candidate organic insecticides and parathion against mature female California red scales on lemons

Insecticide (grams per liter)	Mortality		Adult offspring per sprayed female	
	Test insecticide	Parathion	Test insecticide	Parathion
1958-60 tests				
	Percent	Percent	Number	Number
Bayer 21907:				
0.25	--	63	--	0.41
0.50	44	97	(1/)	0
1.00	72	--	(1/)	--
Bayer 24498:				
0.125	73	--	(1/)	--
0.25	93	86	(1/)	(2/)
0.50	98	96	0.43	.35
DuPont 691 3/:				
0.25	--	63	--	.41
0.50	43	97	.52	0
1.00	31	--	1.40	--
Methyl Trithion:				
0.25	--	86	--	(2/)
0.50	76	96	(1/)	.35
1.00	94	--	.04	--
1961 tests				
Shell SD-3562:				
0.125	54	--	0.06	--
0.25	78	88	.02	0
0.50	95	93	0+	0
Stauffer B-8760:				
0.25	--	90	--	0
0.50	36	89	.45	0
1.00	68	--	.16	--
Stauffer N-2230:				
0.25	--	88	--	0
0.50	50	93	(1/)	0
1.00	76	--	0	--

Stauffer N-2404:				
0.25 - - - - - - - -	--	88	--	0
0.50 - - - - - - - -	83	93	0	0
1.00 - - - - - - - -	76	--	0	--

1962 tests

American Cyanamid CL-43064:				
0.25 - - - - - - - -	45	--	(1/)	--
0.50 - - - - - - - -	81	85	0.24	0.02
1.00 - - - - - - - -	84	85	.03	0+
Bayer 41831:				
0.50 - - - - - - - -	--	85	--	.02
1.00 - - - - - - - -	52	85	.02	0+
2.00 - - - - - - - -	71	--	.09	--
Bayer 46676:				
0.50 - - - - - - - -	--	85	--	0
1.00 - - - - - - - -	79	84	.02	0
2.00 - - - - - - - -	92	--	.01	--

1/ No significant residual action.

2/ New adults not counted.

3/ Emulsifiable concentrate.

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